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(54) IMPROVEMENTS IN STRUCTURAL PANELS OF THE SANDWICH TYPE

(71) We, AVIONS MARCEL DASSAULT-BREGUET AVIATION, a French Body Corporate, of 46, Avenue Kleber, 75-Paris, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to structural panels of the sandwich type comprising a cellular core of the honeycomb kind, on each side of which there adhere covering plates or sheets which are disposed perpendicularly to the partitions of the cellular structure.

The invention refers more particularly to the panels of this kind which are intended for the production of light, strong floors and partitions, especially in the construction of air transparent vehicles. In these panels, as is already known, the cellular structure in the form of a honeycomb is generally made of light metal alloy, while the covering plates or sheets are made of plastics material which is attached to the cross-section of the partitions in the cellular structure.

For the attachment of panels of this kind to the framework intended to support them, use has hitherto been made of metal eyelets, which are often called "inserts" and of which the two parts, which are engaged, on each side of the panel, in a hole previously formed in the latter with a tool, are riveted together by means of pressure, whereupon plastics material is injected into the panel around the eyelet in order to fill up the space left in the cellular structure during the piercing of the hole intended for the location of the eyelet.

This method of procedure suffers from various drawbacks. The eyelets are relatively expensive and greatly increase the cost price of the panel. They create a projection on each of the faces of the panel, so that the panels are supported only locally on the framework by the eyelets, thus contributing to bending between the latter under the effect of loads. Furthermore, the projection of the eyelets on the upper face of the panels causes wearing of the moquette with which the floor is generally covered. Finally, the resistance to tearing of eyelets located at the edge of the panels is not always adequate. Because of this the panels are ruined and have to be replaced.

The present invention aims to make it possible to avoid these drawbacks and, in particular, to obtain a high degree of strength for the points of attachment of the panels, at minimal cost.

According to the invention, there is provided a method of producing attachment zones or locations in a sandwich type panel made up of a cellular structure and of flat coverings disposed on both sides of the said structure and adhering to the latter, wherein, in spaced-apart zones of this structure, which are substantially circular and have a diameter which is appreciably greater than that of the screw or other fixing member to be used and is, moreover, sufficiently great for each of the said zones to encompass a plurality of contiguous cells, a hardenable material is poured into the cells in these zones in such a way as to fill them, while the said structure has still not received at least one of its two coverings, and then, after complete attachment of the said coverings and hardening of the compound, the centre of each zone thus formed is pierced right through to form a hole having substantially the shape and diameter necessary for the passage of the said screw or other fixing member.

The hardenable material is preferably based on plastics material.

The invention also extends to panels

provided with the attachment zones. According to this aspect of the invention, there is provided a sandwich type panel capable of attachment to a support without eyelets or metal inserts mounted in the panel comprising a cellular structure and flat coverings secured to both sides of said structure, wherein the cellular structure comprises spaced-apart zones constituted by a hard material which fills all cells of a plurality of contiguous cells and in which the walls thereof are embedded, and which is covered on both faces by the flat coverings.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a diagrammatic view, in perspective, showing the make-up of a sandwich type panel;

Figure 2 shows a part of a finished panel;

Figure 3 is a cross-section taken along the line III-III in Figure 2; and

Figures 4, 5 and 6 are views in partial cross-section along the line IV-IV in Figure 2 and show successive phases in the production of an attachment node.

In order to produce a sandwich panel of the type under consideration, there is taken, as shown in Figure 1, a cellular structure 1 of the honeycomb kind, which is most often made of light, aluminium-based alloy such as for example the alloy known under the designation AG_5, and of which the cells, which have a hexagonal or other shape, have a relatively small cross-section of the order of a few mm^2. In Figure 1, only a few cells of the structure 1 have been illustrated, in perspective, the dimensions of their transverse section having been enlarged in order to provide clarity in the drawing. Flat coverings 3 and 4 are stuck to both sides of this structure, perpendicularly to the partitions 2 of the cells. In this way, the panel shown in Figures 2 and 3 is obtained.

In order to make up a floor or partition with panels of this kind the panels must be attached at their edges to a framework which is usually metal, and the problem consists in providing, along the edges of the panels, at a slight distance from these edges and at suitably distributed points 5 and also, if necessary, at other points on the panel, holes intended for the passage of screws or other components which will secure the panel to the framework.

As has been mentioned above, use has hitherto been made, at the points 5, of two-piece eyelets which are generally metal and are engaged, on each side of the panel, in holes previously formed in the latter with a tool, and which are riveted together by pressure, whereupon plastics material is poured all round the eyelet between the two covering plates of the panel in order to replace, between these plates, the cell walls which have been destroyed when the hole was pierced. For this purpose, the known eyelets comprise, on one of their collars, holes which permit the passage of an injection needle.

This method of procedure suffers from the drawbacks already mentioned.

According to the invention, a completely different procedure is adopted which avoids the use of metal eyelets.

One method of implementing the present invention involves taking the cellular structure 1, which is not yet provided with the covering 3 and 4, and placing this structure on a slab 6. A plate or template 7 which is the same size as the panel to be produced is placed on the said structure and is pierced with apertures 8, the axes of which coincide with those of the holes 5 which are to be formed in the panel for the passage of attachment screws.

The apertures 8 in the template have a diameter which is very much greater than that of the holes with which the panel is finally to be provided, for example a diameter of about 20 mm. for a hole diameter of between 3 and 5 mm. By means of a moving piston type pressure-injection gun 9, the nozzle 10 of which has the same diameter as the aperture 8, there is injected, through each of these apertures, a plastics material which thus completely fills the cells revealed by the aperture 8, even if the cells remain partly masked at the periphery of this aperture.

This material is such that it has good properties of adhesion to the coverings 3 and 4 which will subsequently be attached to the cellular structure.

The said material is also such that it has thixotropic properties and thus remains in place in the cellular structure without escaping therefrom when the latter is removed from the slab 6 for the purpose of providing it with the covering 3 and 4, preferably by hot pressing.

In the course of this operation, the material which has been poured into the cells hardens and the finished panel thus contains, around the geometrical axes of the holes which are subsequently to be pierced, zones in which the cells are filled with a hard plastics material between the coverings 3 and 4 (these zones have been shown in dotted lines at 11 in Figure 2).

The panel is then taken and again placed on a slab 6*a* (Figure 5) and has superimposed upon it the template 7, the apertures 8 in which are thus again located opposite the zones 11, whereupon, by

means of a drilling gun 12 which is successively placed on each of the apertures 8, and of a diamond-tipped bit 13 which is fitted in the said gun, each hole 5 for the passage of an attachment screw is pierced in the centre of each of the zones 11 which hole may possibly be milled at one or other of its ends.

The slab 6*a* preferably comprises a cut-out portion 6*b* permitting the point of the bit 13 to pass through the panel. In the course of the operation, the assembly constituted by the panel and the template 7 is displaced on the slab (after the gun 12 has been raised vertically) in such a way as to bring each of the holes 8 in the template and each of the attachment zones 11 under the said gun.

Figure 6 shows, in section, one of the panel nodes pierced by the hole 5.

In the course of the operation involving the piercing of the hole 5, only those parts of the cell walls which are located in the cross-section of the hole 5 are destroyed, but all around the said hole, the walls of the cells which are filled with the hardened material remain extant, which explains the remarkable strength of the attachment zone thus produced.

Thus, an attachment location or zone is obtained, without the addition of metal components, which exhibits remarkable properties in respect of strength while still remaining economical to produce and avoiding any detrimental projection on the faces of the panel, which remain perfectly flat.

As an example of a material which is suitable for pouring into the cells in order to make up the zones, attention may be drawn to a mixture of a fluid resin containing its hardening catalyst, and of a very high proportion of finely ground silica (about 250 parts by weight of silica to 100 parts by weight of resin). The ground silica is agglomerated and transforms the fluid resin into a thixotropic product and gives it, after hardening, exceptional hardness and tensile strength. The resin will advantageously be an epoxy resin in the event of the coverings 3 and 4 themselves containing a resin of this type.

It should be noted that an epoxy resin-based compound of this kind is capable of hardening at ambient temperature, which justifies its use for repairs. After polymerisation, the product is self-extinguishing.

The method of implemention described could naturally be modified in various ways.

Thus, for example, in the phase in Figure 4, the use of a special thixotropic material could be avoided if a start were made by sticking one of the covering plates, for example the plate 4, to one of the faces of the cellular structure in such a way that this plate would serve as a base for the pouring of the plastics material into the cells of the honeycomb.

When the panel is finished, it is advantageous to reinforce its edges by milling the cellular structure over a distance of a few mm. between the plates 3 and 4 and by then filling the part thus evacuated, which is shown in shaded form on the left of Figure 3, with a suitable hardenable thixotropic material, for example, with a material similar to the one mentioned above.

The method according to the present invention is not restricted to the above described example but is capable of modification without departing from the scope thereof as defined by the appended claims.

WHAT WE CLAIM IS:—

1. A method of producing attachment zones or locations in a sandwich type panel made up of a cellular structure and of flat coverings disposed on both sides of the said structure and adhering to the latter, wherein, in spaced-apart zones of this structure, which are substantially circular and have a diameter which is appreciably greater than that of the screw or other fixing member to be used and is, moreover, sufficiently great for each of the said zones to encompass a plurality of contiguous cells, a hardenable material is poured into the cells in these zones in such a way as to fill them, while the said structure has still not received at least one of its two coverings, and then, after complete attachment of the said coverings and hardening of the compound, the centre of each zone thus formed is pierced right through to form a hole having substantially the shape and diameter necessary for the passage of the said screw or other fixing member.

2. A method according to claim 1, wherein the hardenable material is plastics based and is thixotropic so that, even before hardening, it remains in the cells into which it has been poured and which it fills.

3. A method according to claim 1 or claim 2, wherein the material is poured into the cells of the circular structure before either of the coverings are secured to said structure, the said structure being placed on a base during this operation.

4. A method according to any preceding claim, wherein the hardenable compound comprises a mixture of fluid resin and finely ground silica.

5. A method according to any preceding claim, wherein for the pouring of the compound into the spaced apart zones

of the cellular structure, there is superimposed up on the said structure a template pierced with apertures, the axes of which coincide with those of the holes to be finally formed in the panel but which have a diameter which is appreciably greater than that of the said holes.

6. A method according to claim 5, wherein the holes are formed in the zones, which have been hardened, by means of a drilling gun which is placed on the apertures in the said template.

7. A method of producing attachment zones or locations in a sandwich type panel, said method being substantially as hereinbefore described with reference to the accompanying drawings.

8. A sandwich type panel capable of attachment to a support without eyelets or metal inserts mounted in the panel comprising a cellular structure and flat coverings secured to both sides of said structure, wherein the cellular structure comprises spaced-apart zones constituted by a hard material which fills all cells of a plurality of contiguous cells and in which the walls thereof are embedded, and which is covered on both faces by the flat coverings.

9. A panel according to claim 8, wherein the said compound contains finely ground silica, the grains of which are agglomerated by a plastics material.

10. A panel according to claim 8 or claim 9, wherein it is pierced by holes which pass through the nodes and are intended for the passage of attachment components, so that the said panel may be attached without eyelets or metal inserts mounted in the panel.

11. A sandwich type panel substantially as hereinbefore described with reference to the accompanying drawings.

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1 420 009 COMPLETE SPECIFICATION
2 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

FIG:1

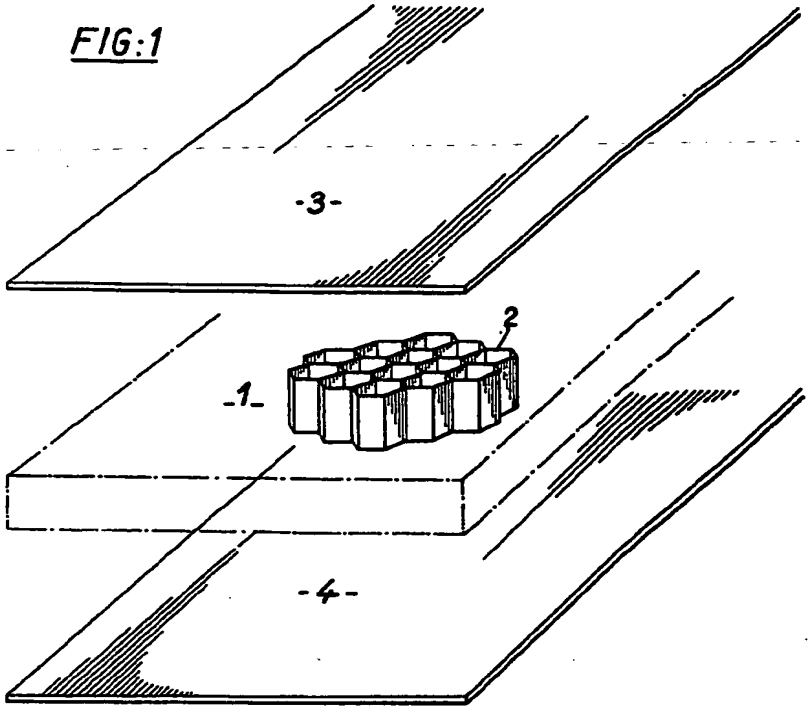


FIG:2

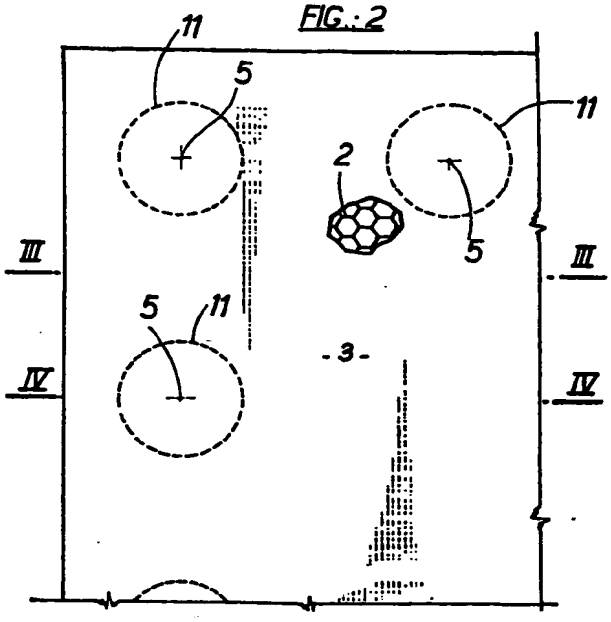
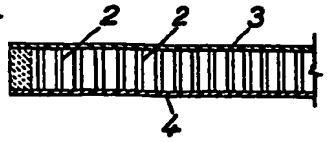


FIG:3



1 420 009 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEET 2

FIG.:4

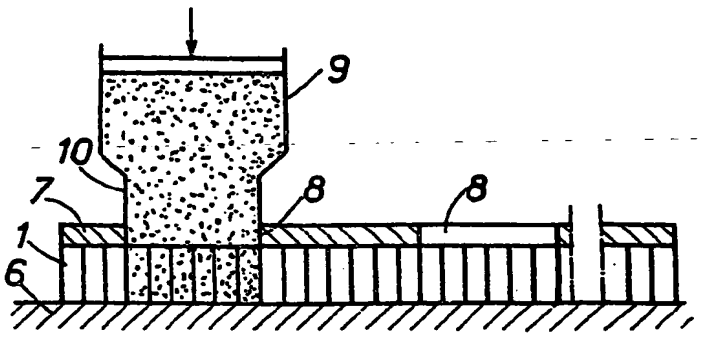


FIG.:5

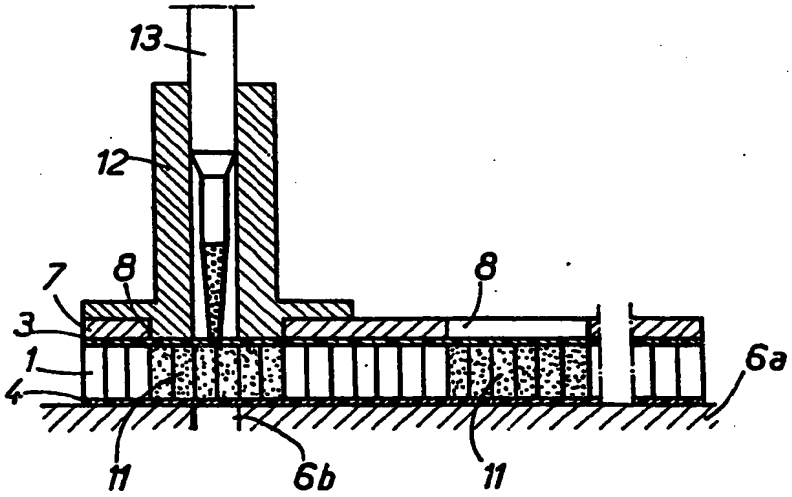


FIG.:6